

Thermally Activated Technologies for High Technology

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My Perspective

- Technology, currently 2nd generation data center company, focus on improved technology, service and operations
- Data centers are the life-support systems of the Internet and electronic business transactions
- Data centers are only one type of technology company that can use improvements in energy technologies



What Makes a Data Center Unique?

- Every business that either conducts business on-line or electronically uses a data center
- Data centers house thousands or even millions of computer devices in one small space
- An outsourced data center is unique because it aggregates hundreds or even thousands of critical business operations into one space, providing higher electrical and thermal reliability, physical and virtual security, redundant high-speed fiber connectivity, and specialized services



It Takes Electricity to Move Electrons of Data



☐☐ ...And Create a lot of Waste Heat





Data Centers and Thermally Activated Technologies

- Reliability and Security
 - Distributed Generation
- Heat Removal
 - About 40% of electricity becomes a wasted by-product—*heat*
 - Servers shrinking in size and yet still using more energy, thus waste heat dilemma growing
- Temperature and Humidity Control
 - Need free cooling
 - Generally need humidification; HVAC naturally dehumidifies
 - Thermal storage usually uneconomical because loads are flat

Energy Generation Wish List

- Must be less than utility cost/kWh
- Achieve reliability goals, usually 99.999-99.9999% uptime
- Combined primary and back-up generation, UPS, PDU, and cooling systems
- Modular and scalable: quick design and build
 - Accommodate all size
- Clean: easy permitting, easy operation
- On-site fuel storage: must be safe and adequate for several days

Heat Removal Wish List

- Remove heat at chip or server (“heat tube”)
 - Likely fluid-based yet no fear of leaks
 - The Race: Liquid cooled chip/server or improved space cooling?
- Heat absorbers or absorption chillers to turn waste heat into free cooling or more electricity (perpetual cooling machine)
- Higher efficiency heat exchangers for all climates
- More efficient ‘economization’ to prevent waste
- Modular and Scalable for quick design and build of all sizes
- Reliable and easy to maintain
- More efficient removal of waste heat and/or turn it into a useful resource
 - Ex: turn heat from DX compressors into hot water
- Provide efficient humidity control for electrostatic reduction and human comfort

Challenges and Barriers

- To provide alternatives with less capital and quicker payback than utility service
 - Utility Service is cheap and usually readily available
 - Socialized, with little demand or upfront costs
 - Companies have to make good financial decisions that quickly respond to market conditions
 - ROI and NPV calculations must compete against alternatives and IRR
 - Make the most of capital investments (none idle)
- The segmented approach
 - Each piece of equipment must work as a holistic system
- Old Trends by Engineers & Architects
 - Easy and quick to design and build to varying sizes
- Operational Efficiency
 - No need for highly skilled laborers
 - Easy maintenance